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14 July 1952

Office of Research and Reports

Materials Division

Petroleum Branch

ESTIMATED CAPABILITIES OF THE USSR TO BUILD

A TRANS-IRANIAN PIPELINE

FROM ABADAN TO THE CASPIAN SEA

(A Preliminary Report)

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17 July 1952 for transmittal to

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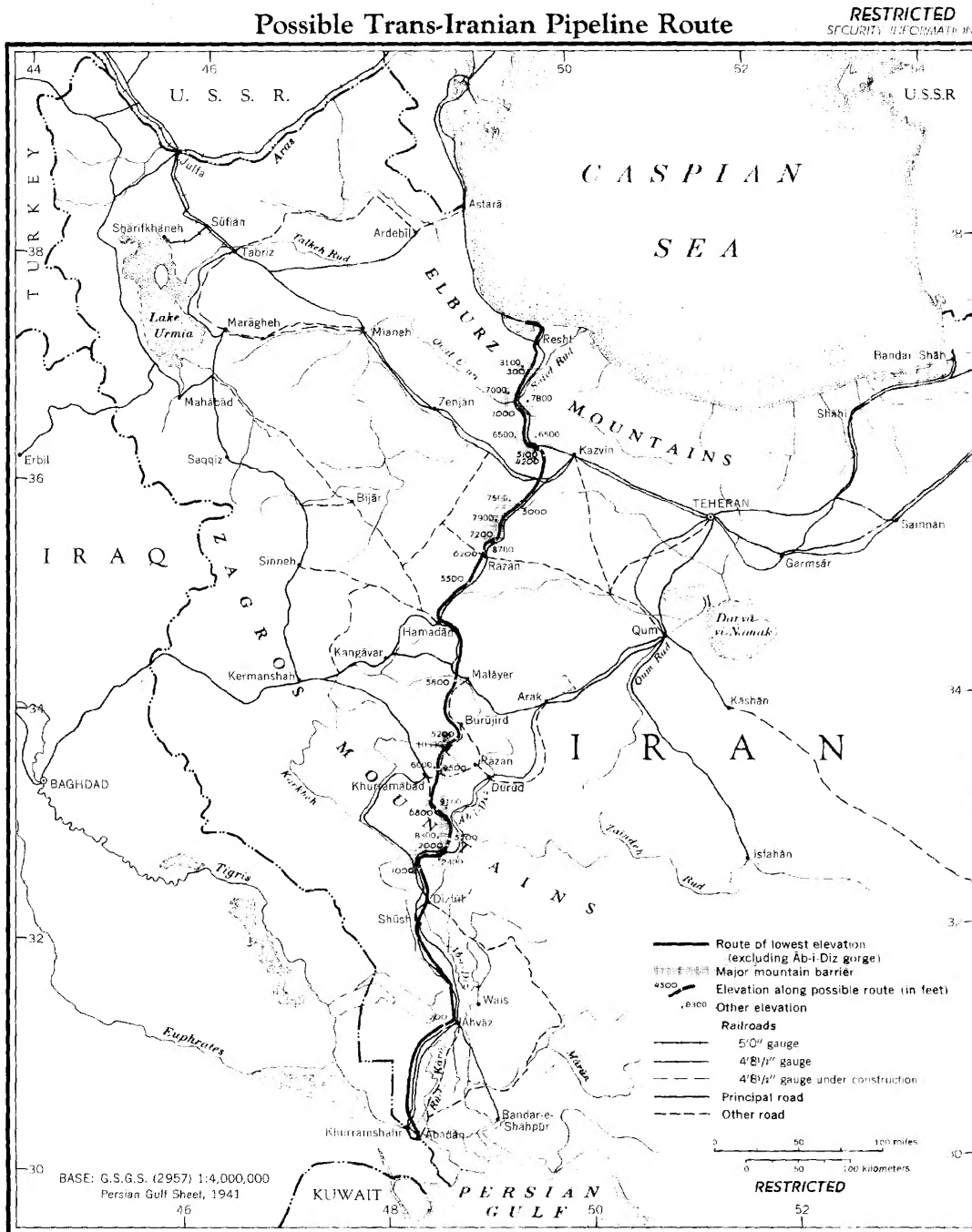
Assumptions

1. That pipe line would be built by the USSR, or by a subservient Iranian Government with full cooperation and supervision of USSR.
2. That line pipe and pumping equipment will be fabricated in the USSR ready for delivery to Iranian ports on the Caspian Sea in advance of construction requirements.
3. That minimum construction time is the primary consideration in the choice of route and size of initial line.
4. That line will be designed for transport of petroleum products, principally gasoline and light distillates, from the Abadan refinery to an Iranian port on the Caspian Sea.
5. That high priority will be assigned by the USSR Government to a Trans-Iranian pipe line.

Summary

1. The most probable route for a Trans-Iranian Pipeline will be as shown on the attached map, from Abadan to the Caspian Sea port of Pahlevi near Rasht. The length of route is 600 miles.
2. In order to deliver petroleum products from Abadan to the USSR as quickly as possible, the USSR could build an initial 15 cm. (6") diameter pipeline over this route, using light weight pipe and portable pumping units. Capacity of this line would be one-half million metric tons annually and minimum time required for construction by USSR is estimated to be six months.
3. That during the six-month construction period on 15 cm. line, plans and surveys could be completed for building a 40 cm. (16") diameter pipe line over this same route. Capacity of this line would be 4.5 million metric tons annually. The estimated minimum time required for construction is one year, over and above the six months preliminary period. Thus in a minimum of 18 months it is estimated the USSR could have installed pipeline capacity from Abadan to the Caspian Sea of 5.0 million tons annually of petroleum products.

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4. The total steel required for line pipe, pumping equipment and tackage is estimated at 88,900 metric tons for the two pipelines. It is estimated that this 18-months Trans-Iranian pipeline program would absorb about two-thirds of the USSR pipeline construction capabilities during this period, which indicates the very high priority needed for completion of the program within the estimated time.

5. The increase of 5 million metric tons annually of petroleum products available to the USSR, effected over a period of 18 months by this Trans-Iranian pipeline, is equal approximately to the normal increase in the availability of petroleum products in the USSR over the same period, resulting from the total expansion effort in the USSR petroleum industry. However, the total effort required for the Trans-Iranian pipeline is very much less than the total effort required to obtain a like increase in availability of petroleum products from the normal expansion of the USSR oil industry.

Availability of pipe and equipment

There is not, at present, sufficient finished intelligence available to evaluate the USSR current capability to produce line pipe and pumping equipment, nor is there available evidence on stocks of such pipe or equipment. Therefore, a review of pipe-line construction in the USSR is used to estimate its capabilities to fabricate the pipe and manufacture the pumping equipment needed for a Trans-Iranian pipe line.

In January 1951 there were known to be 6,500 miles of oil and gas pipe lines in operation in the USSR and an additional 3,200 miles were probably completed as of that date. It is, therefore, assumed that the USSR now has at least 10,000 miles of oil and gas pipe line in operation. Less than 1,000 miles of these pipelines were in use when the Communists seized power after World War I, so practically all of the pipelines in the USSR were built by the present USSR government. Most of the pipe lines have been built since 1930 and at least 3,500 miles of line have been built since 1940.

There were at least 300 miles of pipe lines completed in the USSR in 1947 and at least 680 miles completed in 1948. There is no evidence to indicate a reduction in pipeline building since 1948. About 1,200 miles of pipeline building were being built in 1950 and another 2,500 miles were planned. It is clear that USSR pipeline building is currently at the rate of not less than 1,000 miles annually. This compares with 1952 scheduled completions in the US of 10,000 miles

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of oil pipe lines only, involving use of 0.9 million tons of steel. Also an additional 1.5 million tons of steel has been allocated to gas pipe line construction in the US during 1952.

Pipe fabricated to US standards (API) and imported largely from the US was used in the USSR during the 1930's. Since World War II increasing quantities of line pipe have been manufactured in the USSR. Specifications conform closely to US standards but sizes are reported in centimeters instead of inches so that standard sizes are not exactly comparable.

Post-war pipeline completions in the USSR have ranged in size from 15 cm. (6") diameter to 60 cm. (24") diameter, with most of the longer oil pipelines in the 30 cm. (12") diameter size. The only 30 cm. diameter line known to be in operation is a 125-mile gas line serving Leningrad which was completed in 1948.

It is estimated that the requirements for a 30 cm. diameter Trans-Iranian pipeline represent about one-half of the USSR's current annual oil and gas pipeline construction program.

Approximate pipe sizes and probable location of Trans-Iranian pipe line

Generally, petroleum products pipelines are smaller diameter than crude oil lines. This is reflected in the following table showing the five longest US pipelines in each of these categories which are scheduled for completion in 1952.

<u>Products pipelines</u>		<u>Crude Oil pipelines</u>	
<u>Length miles</u>	<u>Diameter inches</u>	<u>Length miles</u>	<u>Diameter inches</u>
933	8",10",12"	1,080	16",20"
554	8",14"	683	22",24"
329	8"	577	20",26"
316	12"	463	24"
310	6",8"	319	10",12",22"

Several factors are involved in the choice of diameter for a given pipeline. Although the diameter of the pipe is the dominant factor controlling the maximum capacity over a given pipeline route, the number of pump stations on the route determines its transport capacity up to its maximum. The diameter may be selected on the basis of the estimated ultimate capacity demand, and the number

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of pump stations installed initially may be limited to the initial capacity demand. For example, the Alberta-Vancouver Trans-Mountain crude oil pipeline now under construction in Canada will have an initial ^a capacity of 75,000 barrels/daily with two pump stations, but its optimum ultimate capacity will be 200,000 barrels daily when a total of five pump stations are in operation. This is a 24" diameter line 695 miles long. The actual construction time is estimated at 16 months.

So-called "looping" or laying additional parallel pipe lines over a given route is also used to increase the transport capacity of the route. This is widely used for natural gas transport where the initial market demand for natural gas in a new area is small compared to the demand a few years later.

In choosing the diameter of pipe for a Trans-Iranian products line from Abadan to the Caspian Sea, it is assumed that the USSR would follow US practice, but modified to meet the particular engineering, economic, strategic and political factors involved. The assumption of minimum construction time for the initial line would indicate the choice of a small diameter pipe, but one with sufficient capacity to make a worthwhile contribution to USSR product availability in some strategically important category such as aviation gasoline. This initial line could be paralleled later with one or more larger diameter pipes to make a greater and more diversified contribution to the availability of petroleum products in the USSR.

The attached map shows a possible Trans-Iranian pipeline route from Abadan to the Caspian Sea. For several reasons this is believed to be the most probable route for such a pipeline. Any route must cross two mountain ranges. The route shown crosses three mountain barriers as indicated on the map, but the third one north of Razan is the least difficult and this route cuts the distance to 600 miles. An alternate route following the railroad through Qum and Teheran to Bandar Shah on the Caspian Sea would be about 300 miles longer. Although this alternate route would avoid the third mountain barrier north of Razan, the crossing of the Elburz Mountains between Teheran and Bandar Shah is extremely difficult compared to the crossing of these mountains between Kazvin and Resht shown on the map. Furthermore, the port at Pahlevi, 23 miles from Resht is now considered to be the principal Iranian port on the Caspian Sea, as the capacity of the port of Bandar Shah, used during World War II is seriously reduced by silting. Also Baku and other important USSR Caspian Sea ports are closer to

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BASIC DATA FOR 600-MILE PETROLEUM PRODUCTS PIPE LINE

Nominal Diameter ins (ins)	Operating Pressure PSIG	Number of Pump Stations	Capacity 100% load factor		Line Pipe	Steel Requirements - Metric Tons			Metric tons of products moved annually per ton steel
			Thousand Barrels per day	Million Metric Tons annually a/		Stations	Tankage	Total	
15* (6")	500	40	12.0	0.515	16,200	100	3,600	19,900	25.9
20 (8")	1,300	12	30.0	1.288	27,200	900	3,600	31,700	40.7
25 (10")	1,300	11	52.3	2.245	41,400	900	3,400	45,700	49.1
30 (12")	1,200	10	76.5	3.283	48,800	900	3,200	52,900	62.0
35 (14")	1,200	10	99.7	4.281	56,600	900	3,200	60,700	70.6
40 (16")	990	9	120.0	5.155	63,700	1,000	4,300	69,000	74.7
45 (18")	950	8	151.0	6.485	73,500	1,000	5,200	79,700	81.4
50 (20")	950	6	183.9	7.898	84,400	1,000	6,400	91,800	86.1
60 (24")	860	6	285.6	12.263	113,200	1,400	6,400	121,000	101.3

Closest nominal size API Line Pipe in inches shown in parentheses. Steel requirements are based upon these API sizes and US practices.

* Assumes light weight pipe with portable US Army type pumping units.

a/ Conversion based on motor gasoline, 3.50 barrels per metric ton.

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Pahlevi than to Bandar Shah.

For the route shown on the map, line pipe, pumping equipment and pipeline construction crews and equipment could be discharged both at Pahlevi for transport thru Resht by truck for the northern part of the line, and at Bandar Shah for transport by rail for the southern part of the line. For the intermediate part of the line north and south from Halyar, delivery can be made by truck from a railroad at Arak.

Highways parallel practically the entire pipeline route shown on the map. These highways are described as bituminous surface, 20 feet wide and mostly in poor surface condition. It is unlikely they would stand up under the very heavy loads incident to modern construction of large diameter pipelines. However, for small and medium diameter pipeline construction and moderate loading these highways would be suitable, although some bottlenecks such as short radius curves and steep grades in the mountain sections would retard operations.

Pipe diameters, capacities, steel requirements and construction time over probable 600 mile route.

The attached table gives basic data for a 600 mile petroleum products pipeline for various USSR standard line pipe diameters from 15 cm. (6") to 60 cm. (24"). The operating pressures, number of pump stations, capacities and steel requirements are based upon US standards and practices. USSR capabilities to transport petroleum products from Abadan to Pahlevi on the Caspian Sea, estimated on the basis of the data given in this table should be considered a maximum. Actual USSR capabilities may range down to 70 percent of these maximums for the smaller sizes of pipe and down to 50 percent of these maximums for the larger diameters.

The first line in the table covering a 15 cm. (6") diameter light-weight pipe in conjunction with pre-assembled portable pumping units, is of particular interest if it is assumed that actual delivery of petroleum products in the shortest possible time is of primary concern to the USSR. Such a line would be similar to the military oil pipelines laid so rapidly by the Allies in World War II, but would be welded rather than coupled. In India and Burma, during World War II a 750-mile, 6" pipeline was completed over a period of five months under conditions much worse than those which would be encountered on the Abadan-Pahlevi route. Parts of this line were standard weight welded rather than light weight coupled as in the usual military line. The capacity of about one-half million metric tons annually for this 15 cm. line is conservative as it is based upon a limiting

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operating pressure of 500 psi on the portable pumping units, while this weight of pipe would have a working pressure at least 50% higher. It is probable that the USSR can produce portable pumping units to operate at a pressure somewhat above the 500 psi assumed in the table.

The total steel requirements of 19,900 metric tons for a 15cm. diameter line, together with the pipeline construction equipment and crews to build such a line, would not impose a difficult transportation load on marine shipping on the Caspian Sea; on the ports at Pahlevi and Banar Shah, or on the railroad and truck transport needed for delivery on the pipeline route. Even though the total load for material, equipment and supplies for such a 15 cm. line amounted to 50,000 metric tons, such a quantity is small compared to the Allied shipments during World War II northward over the Trans-Iranian railway from the Persian Gulf to Banadar Shah on the Caspian Sea, and thence to the USSR by sea transport, which was at a maximum rate of 238,450 tons per month.

Assuming the line pipe, portable pumping equipment and pipeline construction equipment and crews were assembled at Baku, it is estimated that the USSR could complete a 6" pipeline from Abadan to Pahlevi in six months, ready for delivery of aviation gasoline or other selected light products to USSR Caspian Sea tankers at a rate of 500,000 metric tons per year. As of 30 August 1951 available stocks of gasoline and kerosene at Abadan were about 500,000 metric tons or enough to operate such a 15 cm. pipeline for one year. These stocks included only about 25,000 tons of aviation gasoline.

In the US, pipeline contractors classify their construction equipment and crews in three categories according to the diameter of the pipe handled. In pipeline contractors' terminology a "pipeline spread" comprises the many items of equipment and operating personnel needed to construct a pipeline or any segment of a pipeline. A 1950 survey of 142 US pipeline contractors revealed a maximum capacity of 482 spreads for gathering lines 6" diameter and under; 341 spreads for trunk lines from 6" to 15" diameter, and 156 spreads for big inch lines 16" diameter and over, or a total of 981 spreads in the three categories, with a total of 64,402 employees. On longer lines several spreads operate simultaneously, building different segments of the route so that such lines are completed in a remarkably short time.

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Most of the post-war pipeline construction in the USSR has been 25 to 40 cms. diameter and it appears probable that most of the pipeline spread are able to build pipelines in this size range. Only three pipelines of 60 and 80 cm. diameter are known to have been built and it is probable that special equipment and crews were assembled for those larger lines. It appears reasonable to assume that the USSR would choose the largest diameter pipe readily available and widely used in the USSR for use on a large capacity products line from Abadan to the Caspian Sea. Such a choice would indicate the use of 40 cm. pipe, which has, as shown in the table a maximum capacity of 5.155 million tons annually and would require 69,000 tons of steel. It is estimated that the actual capacity of such a line as built and operated by the USSR would be 4.0 to 4.5 million metric tons annually, or of the order of 100,000 barrels daily. Therefore, this line, operated in conjunction with the preliminary 6" line would deliver five million tons of petroleum products annually from Abadan to USSR tankers on the Caspian Sea. This would be about one-fifth of the product capacity of the Abadan refinery.

If it is assumed that the USSR met the petroleum products requirements of the Soviet Far East and of Southeast Asia (Iran to Indo-China), by operation of the Abadan refinery there would remain nearly 15 million tons annually of petroleum products capacity at Abadan which could be shipped to the USSR by laying, two addition 40 cm. diameter pipes or one 60 cm. diameter pipe along the assumed pipeline route from Abadan to Pahlevi.

Although a 15 cm. diameter "military type" pipeline with portable pumping units can be built hurriedly and with a minimum of preparation such as surveys and engineering design, the construction of a 40 cm. diameter line with its large stationary pump stations and necessary transportation and communication facilities requires several months preparation before the actual flow of materials can be started. However, if this preliminary work was done during the six months period in which the 15 cm. line was being laid, and if the materials, equipment and personnel for the 40 cm. line were assembled at Baku during this period, it is estimated that the USSR could complete a 40 cm. diameter pipeline over this same route from Abadan to Pahlevi in one year after the completion of the 15 cm. line. This estimate means that in 18 months after the USSR initiated the program as outlined, delivery of petroleum products from Abadan to USSR tankers on the Caspian Sea could begin at the rate of 5 million tons annually.

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The time estimates of six months for the 15 cm. line and an additional 12 months for the 40 cm. line is based upon very high priorities being assigned this work by the USSR government, as stated in the assumptions.

After completion of the 40 cm. diameter line, a 60 cm. diameter line or two more 40 cm. diameter lines to absorb the entire surplus output capacity at Abadan could be built in another one to three years depending upon the priority assigned.

Conclusion and sources

This preliminary report presents a quick appraisal of the estimated maximum capabilities of the USSR to build a Trans-Iranian pipeline route to deliver petroleum products from the Abadan refinery to the Caspian Sea. Sources used were those readily available and they were accepted for use in this preliminary report without extensive cross-checking or evaluation. Where conflicts were found in the source material they were resolved in favor of increasing rather than decreasing USSR capabilities. Sources used are as follows:

1. Draft of M/P report on Soviet Use of Iranian Oil, Project 71-1.

This report is scheduled for revision and completion in FY 1963. Secret.

2. NIS-26, Sec. 54, Chap. IIX, USSR Pipeline. Army, May 1951.

Confidential.

3. NIS-33, Sec. 34, Chap. IIX, Iran Petroleum Pipelines, Army.

November 1948. Confidential.

4. NIS-33, Sec. 32, Chap. IIX, Iran Railways. Army, ^{High} ~~October 1948~~ ^{December 1950}.

Confidential.

5. NIS-33, Sec. 31, Chap. IIX, Iran Railways. Army, December 1950.

Confidential.

6. Map of Iran. Scale 1:2,500,000. Shows pipelines, railways, highways, ports, topography, etc.. This is the best map available of Iran according to D/G. AMS-KPOL, First Edition, February 1952.

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8. Military Pipeline Systems, A World War II Development, by J. J. King, Texas Co., Petroleum Engineer, Vol. 17, No. 6, March 1946, pp. 150-6.

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9. Pumps for Army Pipelines, Petroleum Engineer, Vol. 12, No. 12, December 1960, p. D-13.

10. Greatest Oil Pipeline Year, by John E. Boice, Petroleum Engineer, Vol. 24, No. 6, June 1962, pp. D-22 to E-30.

11. Transportation of Oil, Petroleum Administration for Defense, December 1961. Data in table is largely computed from Table 3 on page 25 of this publication.

12. A Census of Pipeline Construction Contractors, Oil and Gas Journal, Vol. 49, No. 20, September 21, 1960, pp. 136-9.

13. M/P memorandum for files, 15 April 1962, Subject: "Alberta-Texas-Trans-Alberta Oil Pipeline."

14. M/P memorandum for record, 8 July 1962, Subject: "Petroleum Stocks in Iran."

15. M/P contribution to Project 110-51, Unpublished, Secret. In terms of total steel requirements, 110-51 preliminary estimates place total annual input to the USSR oil industry for expansion and operation in the range of 650,000 to 1,000,000 metric tons per year. The Trans-Iranian pipeline program outlined in this report would require not over one-tenth of this minimum input, and would provide a non-declining source of petroleum products as compared with an average annual decline of at least 10 percent on crude oil sources within the USSR.

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following excerpts are quoted from this report.

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"2. I have heard much discussion about the possibility of the Soviets building a pipeline from Iranian oil fields to the Caspian Sea if they ever acquired military control of the Middle East. I think such construction is not only possible, but feasible. Of course, I knew little of the technical competence of Soviet engineers in regard to pipe line construction, but I'm sure that, given men and materials, I could build such a line, making refined products from Abadan to the Caspian Sea in less than a year...."

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12. A Census of Pipeline Construction Contractors, Oil and Gas Journal, Vol. 49, No. 20, September 21, 1950, pp. 188-9.

13. M/P memorandum for files, 15 April 1952, Subject: "Alberta-Vancouver Trans-Mountain Oil Pipeline."

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25X1X616. [REDACTED] with many years' experience in pipeline construction and maintenance, who has visited Iran, believes that construction of a pipeline to deliver petroleum products from Abadan to the Caspian Sea is not only possible but feasible. He states that, given men and materials, he could build such a line in less than a year.

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